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Cambio

***A File Format Translation and Analysis Application
Now Being Integrated with Nucleonica***

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
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What Cambio does

- **Reads** essential data for analysis from over 50 formats from instruments in common use for detecting illicit nuclear trafficking. The goal is every possible format.
- **Converts** spectra to several formats that are commonly used for analysis.
- **Not yet enabled on the Nucleonica site:**
 - **Tools** for comparing spectra and calibrating spectra.
 - **Analysis** suited especially for HPGe spectra.
 - **Batch processing** to automatically translate a large number of files to several formats (e.g., IAEA SPE and XML N42).

How Cambio works

- **The file is searched for patterns that indicate what kind of file it is.**
 - File extensions (such as DAT, CNF, SPE, etc) are not used at first – this is because sometimes several different formats use the same extension, sometimes the file extensions are changed or missing
- **An attempt to read the most probable format is made.**
 - If the data cannot be read, the next most likely format is read.
 - If data does not look reasonable it is identified with a warning
- **If there is no success after trying every possible format, then an attempt is made to extract the data -- even from an unknown binary file -- by searching for signatures of gamma data:**
 - A string of non-negative numbers greater than 255
 - Related locally by Poisson statistics

Some formats that Cambio can read

- ANSI N42.42
- Aspect MKC (A-02, A-03)
- Atomtex
- Berkeley Nucleonics SAM-935 and SAM-940 with QCC decompression and linearization
- Berthold LB-125 (includes multi-record files)
- Canberra CAM format (*.cnf) (includes detection of “counterfeit” variants)
- Canberra Accuspec (*.dat)
- Canberra Programmers Toolkit (*.tka)
- Canberra Inspector 1000 specific CAM format (*.cnf)
- CTC “MCS”
- Davidson (4 variants)
- Exploranium (multi-record files): Gr-130, Gr-135 v1 (2 variants), Gr-135 v2 (2 variants), ASCII (3 variants)
- FieldSpec (now IdentiFinder): Native SPC, FieldSpec-N variant, SPE
- GADRAS (includes multi-record files): PCF, PCC (RAID, RIS, SMART), ASC
- LANL: GN-2 (multirecord); GN-3 (4 variants) (multi-record); Palm Pilot
- IAEA Generic SPE; Mini-MCA (*.spe); 3 methods date and time; 3 polynomial energy calibration; energy calibration from a series of channel-energy pairs
- Ortec: CHN, SPC (both integer and floating), SPE, Print-to-file ASCII
- LSRM
- PDR-78 (file extensions are actually sequence numbers)
- PGT Avalon (*.ans): Revision 1; Revision 2 and above
- Quantrad Ranger (multi-record)
- Rainbow Model 7010
- RobFit (FREE, HDTA, Z4DA; real and integer)
- SAIC RadSmart
- STE Pager-X
- STL Cadillac (ASC and CSV)
- STL Yugo
- Target NanoSpec
- TRACS
- XIA Polaris (*.itx)
- XRF ICS-4000 (2 variants)



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Data elements that Cambio tries to read

- **Spectral channel data (number of counts in each channel)**
- **Number of channels**
- **Number of spectral records in the file**
- **Energy calibration (if present)**
- **Date and time that the data were taken**
- **Real time (duration of the spectral acquisition)**
- **Live time (time that the electronics were available)**
- **Comments (provision for two different comments)**
- **Neutron counts**
- **Neutron acquisition time**
- **Background neutron counts**

How missing data is indicated

- **If converted to IAEA SPE on Nucleonica, Cambio adds diagnostic information at the end of the SPE file.**
- **Standalone Cambio:**
 - **If no reasonable energy calibration can be found, the spectrum is displayed with “Channels” on the horizontal axis.**
 - **If no reasonable date and time of creation, live time, or real time can be found, default data are displayed in a red field and an error message is displayed.**



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Organization of the IAEA SPE Format

\$SPEC_ID:

None

\$MEAS_TIM:

283.97 300.00

\$DATE_MEA:

6/17/2004 13:40:55

\$DATA:

1 1024

0

4

...

0

\$MCA_CAL:

3

0.115 2.876045 0.000602373737

\$XXX

(for specialized applications)

Example diagnostics at the end of SPE

| **\$CAMBIO:**
| Parent file specification: C:\Nucleonica\ExploraniumGR135_Version2a_3514N.DAT
| Successful read of spectrum: Yes
| Error message: None
| Warning: None
| Information: None
| Neutrons: 1
| Number of spectral records in the parent file: 2
| Record number of this spectrum in the parent file: 2
| Date and time of acquisition read successfully from the original file: Yes
| Live time read successfully from the original file: Yes
| True time read successfully from the original file: Yes
| GADRAS Tag character is: N
| Version: 090519
| Parent file type: GR-135 v2, Serial #3514, RecordSize: 2124 bytes

Some formats that Cambio can write to

- **Recommended (any number of channels)**
 - IAEA SPE (best for Nucleonica at present)
 - ANSI N42.42 XML
 - ORTEC CHN
 - Channel-Tab-Value ASCII
 - Excel CSV
- **Training and Simulation (fixed channels, faults)**
 - ICX SPC identiFINDER (formerly FieldSpec)
 - ORTEC SPC for Detective EX
 - Canberra Accuspec DAT
 - Gr-130 DAT (Exploranium-SAIC)
 - Gr-135 DAT (Exploranium-SAIC)
- **Specialized**
 - GADRAS PCF
 - GADRAS ASC
- **Coming soon**
 - HPRDS
 - Canberra CNF
 - InterWinner (Jeetesh Keshaw request)

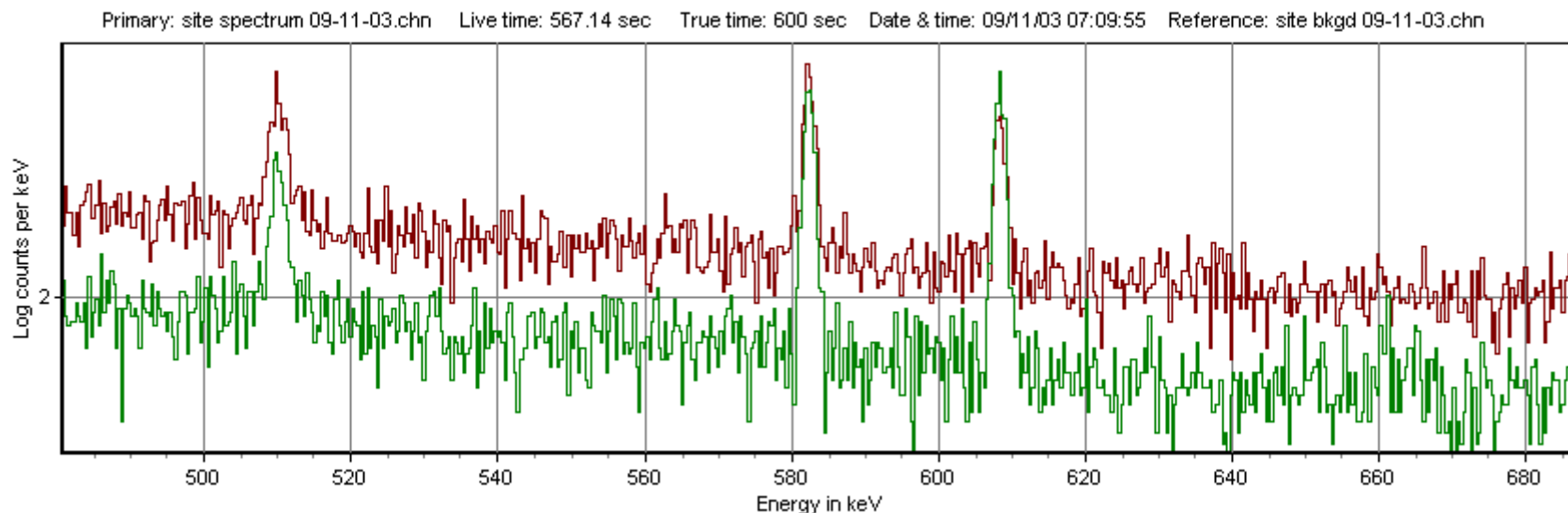
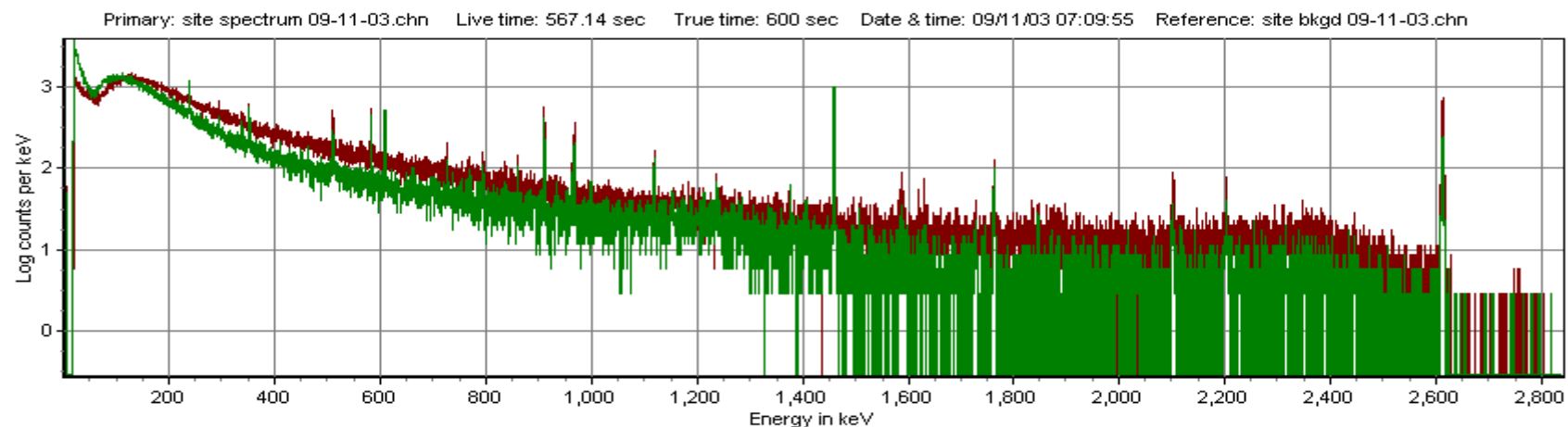
Some tools that Cambio provides

- Comparison by overlaying up to 3 spectra
- Rebinning to a desired energy calibration
- Faulty spectrum repair
- Analyzable spectrum from a bitmap graphic
- Sum spectra
- Sample a spectrum
- Peak area 1 & 2, elapsed time, half-life relation
- Peak area 1 & 2, Distance 1 & 2, source location
- Compton edge and backscatter peak from energy and angle
- Minimum mass from activity
- HPGe efficiency relative to 3x3 NaI



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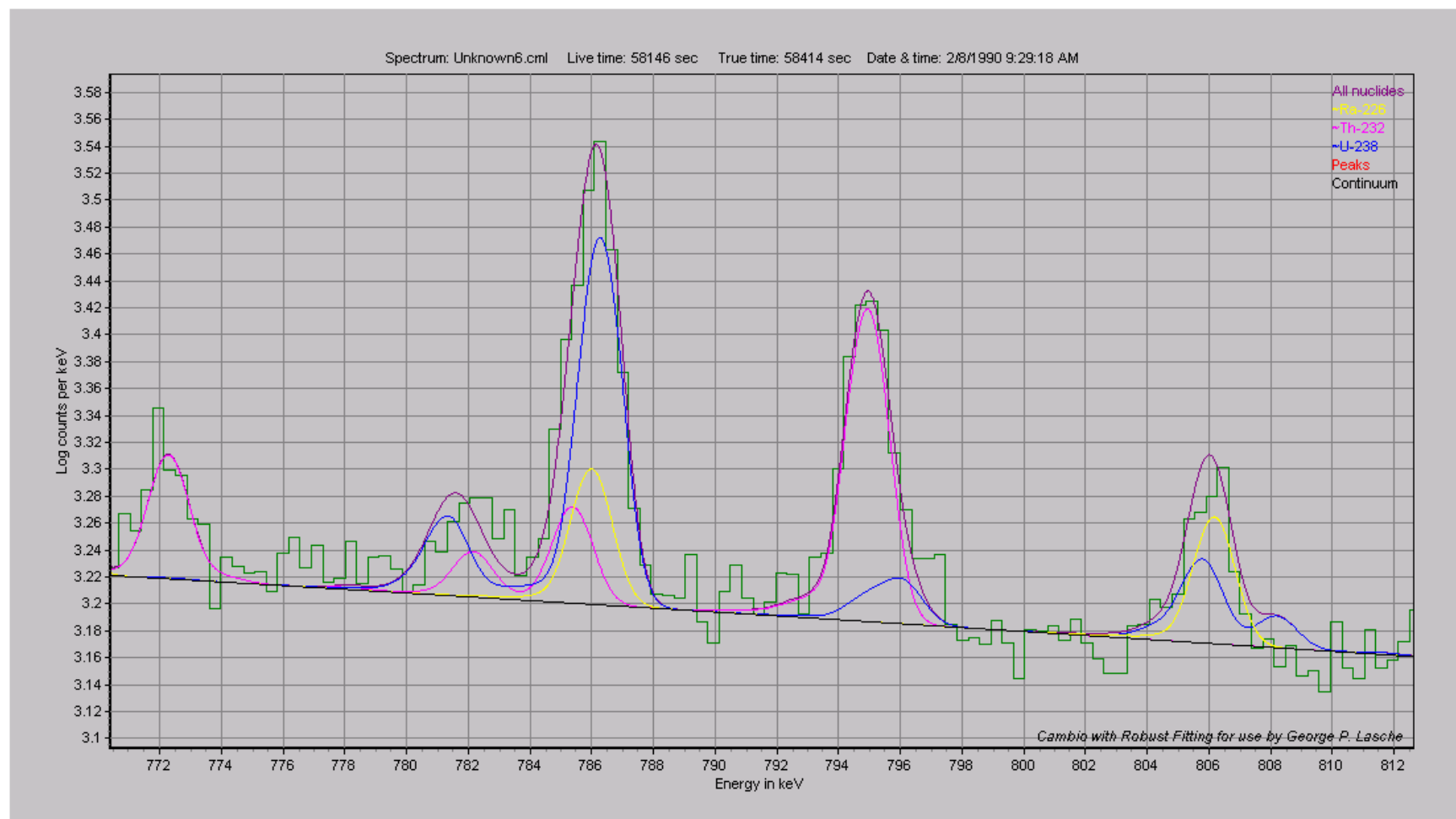
Cambio has tools for graphics display, calibration, and spectrum comparison





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Cambio has analysis tools (still in development) especially suited for HPGe spectra



Some known problems with Cambio on the Nucleonica site now being resolved

- *Just fixed: File names cannot contain spaces (solution: replace spaces with underscores).*
- **Currently the “Spectrum” display only works for the IAEA SPE format, and does not yet plot as a function of energy.**
- *Just fixed: Saving to the N42 XML format writes each spectrum twice in the same file.*
- **Only one spectrum can be read from multi-record files.**
 - The last spectrum if saving to a one-record format,
 - The first spectrum if saving to a multi-record format.



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Registration for Cambio

- Send an email to George Lasche at gplasch@sandia.gov
- Please include your **name** and **organization** with your request.
- Download instructions and notifications of updates will be emailed to all registered users.